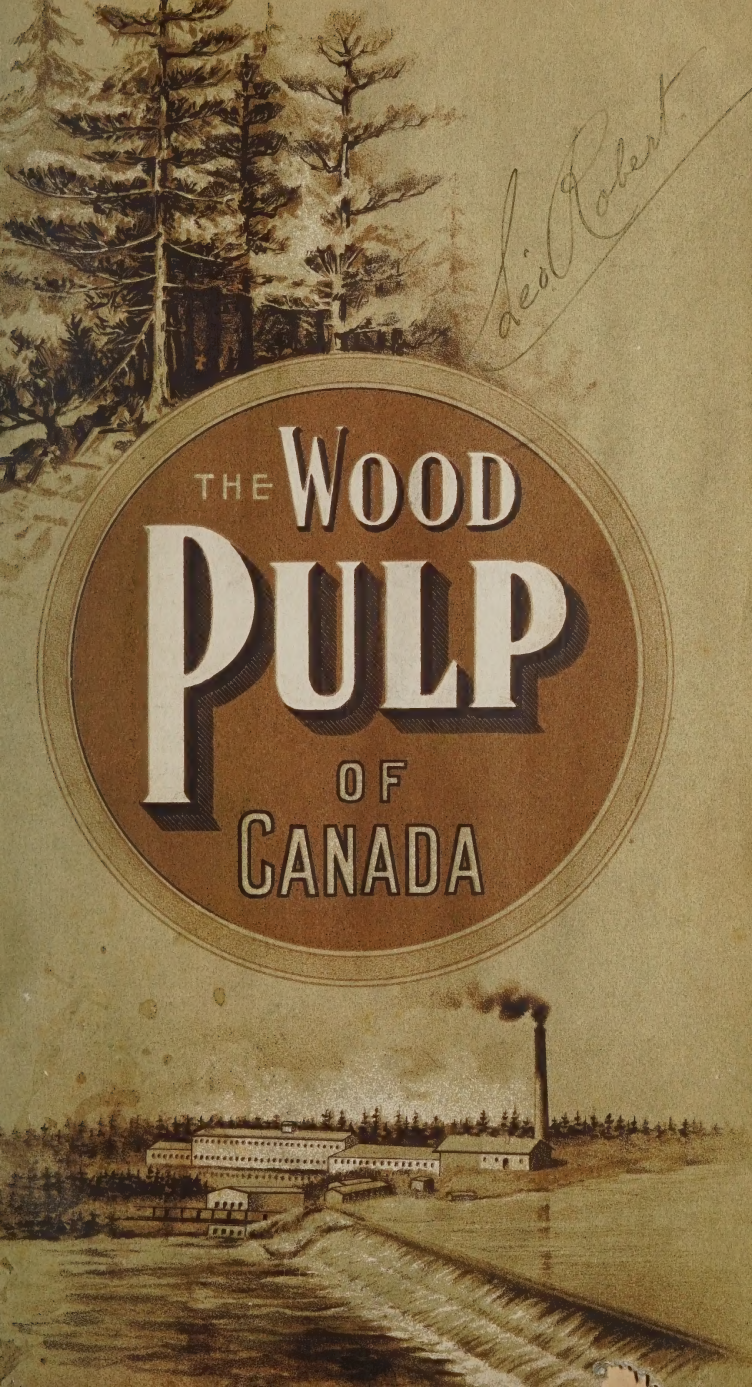
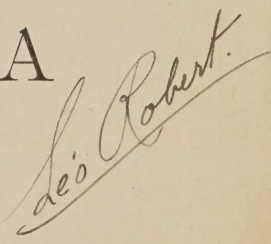

THE WOOD
PULP
OF
CANADA

PARIS INTERNATIONAL EXHIBITION
1900

PULP WOOD
OF
CANADA



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1900

Pulp Wood and Wood Pulp in Canada.

BY GEORGE JOHNSON, F.S.S. (Hon.)

EGYPT AND CANADA.—The first was the land of the early paper plant; the second is the country of the latest paper tree.

Egypt was the land of the papyrus, from which the ancient dwellers on the banks of the Nile obtained the material on which to write those well nigh imperishable records which, three thousand years after they were stored away, have been produced from their hiding places looking as fresh with their cuttle-fish ink as though indited but yesterday.

The Papyrus, "the paper-reed of the brook," gave us the name "paper." The word "library" in English, and the French word "libraire," preserve for us a record of the fact that books were once formed of the bark (liber) of trees. The French word "livre" traces its origin to the same source. The English word "book" comes from the Anglo-Saxon word "boc," the beech tree; and was so derived because the early Anglo-Saxons, like the other Teutonic tribes, used the bark and wood of that tree for writing material.

In modern times we have reverted to the ways of our ancestors and have gone back to the arboreal growth for the supply of paper to meet the world's marvellous demands.

The banks of the Nile were the early store-house of the paper supply. The beech groves of Germany and of England succeeded Egypt. Then towards the close of the 19th century came the opening up of the Canadian spruce forests.

The slopes of the St. Lawrence, the St. Maurice, the Ottawa, the St. John, the Ste. Marie, the Fraser and the Qu'Appelle rivers are substituted for the Nile and the rivers of Europe. The eyes of commerce turn to the New World with confidence that there need not be a famine of paper while the spruce flourishes in Canada.

The centuries of the Pyramid-builders and the 20th century—the latest born—salute each other within the shades of Canadian forests.

Through the experiments of a student, working in the quiet of a German laboratory, untold millions have been added to the wealth of Canada.

The Cinderella of the forest trees of Canada takes rank with the best of her sisters and becomes the idol of popular interest, scattering largess among thousands of toilers.*

At what time in the world's history paper began to be used is a question surrounded with obscurity.

The Chinese appear to have employed the wood of the cotton plant reduced to a pulp in the manufacture of their paper. The first rude efforts in other parts of Asia to secure a material suitable for the purposes of man, as a record of his thoughts and transactions, can be traced beyond the Christian era back to the second century, B.C.

When the Arabs captured Samarcand, 704 A.D., they found the people skilled in the manufacture of paper from cotton and, learning the art, rapidly disseminated the knowledge throughout their empire.

The product of their skill thus acquired from the East became known as Charta—a specially fine quality being called Charta Damascena, from the fact of the best equipped factories being in operation in Damascus.

In Egypt there had been for many years a paper manufactured from papyrus, a member of the vegetable

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*The Shawinegan Water and Power Company is less than a year old, but it has built up a prosperous village of 1,500 people where no one ever dreamed of living, and, within another twelve months Shawinegan Falls will be a town of 5,000 inhabitants.

world which, like the palm, was employed for a great variety of purposes. From the stem of papyrus were made boats, sails, mats, cloth, cords and paper. The pith was used for food. Sandals were made out of a material provided by the papyrus. The seams of ships were caulked with a tow made from it.

But the Asiatic plan of making paper from cotton seems to have spread all along the northern shores of Europe, to Greece, to Italy and to have been carried by the Moors to Spain.

As the industry went further and further afield from the home of the cotton plant, the ingenuity of man sought out other material from which to make the paper. In some cases a fair paper was produced by the mixture of woollen rags with the original material. Linen rags were added in countries where the flax plant flourished.

By the 14th century paper-making had become a recognized European industry.

At first Italy became the centre of the paper-making industry. Then Germany began to build factories after 1320, A.D. France secured her knowledge of paper-making from Spain late in the 12th Century; the early paper being made of cotton.

By the 14th century paper was not uncommon in England.

At first paper was made entirely by hand. Then, as in the history of most manufactures, machinery was invented for the more rapid preparation; then came the division into writing paper, printing paper and wrapping paper, cotton rags being still the chief source of the material from which paper was made.

The demand becoming greater than the supply, the wit of man became actively engaged in finding material from other plants possessed of the necessary fibre. The cotton plant, the papyrus and the palm, flax and some other members of the vegetable kingdom had been employed. But still the demands for paper were inexorable and constantly enlarging.

Every zone was searched for suitable material. It

was thought that in Esparto grass the requisite material had been discovered, and for years Esparto, treated after a somewhat similar fashion as rags, was extensively used.

The tenacity of fibre and flexibility of the leaves have led to their use for centuries for making ropes, sandals, baskets and ships' cables, and because they contain 56 per cent. by weight of fibre, or ten per cent. more than straw, they came into requisition as a substitute for linen rags in the manufacture of paper. About 200,000 tons of the fibre have been imported yearly into Great Britain during the past fifteen years, and its use continues to be maintained at about that rate, without, however, showing any tendency to increase.

Straw, de gras from Northern Africa, the leaves of the dwarf palm, sugar cane refuse, the stalks of the hop plant, nettles, the American thistle, peat and other articles have been successively or simultaneously experimented with in the hope of securing an ideal paper.

Bamboo cane has also been made the subject of experimentation.

Naturally those who were in search of a good material for the manufacture of fibre, reverting to the early employment of the palm tree for the purpose, began to experiment on other wood fibres.

In the year 1845, Keller took out a patent in Saxony for a process of manufacturing paper from ground wood. Before that date its pre-industrial history is known only to the chemist. After that date many improvements were made in the machinery and methods used in grinding, the main object being to produce a longer and finer fibre.

Business men soon began to realize that the students were on the right track. The chemists thus encouraged, made a series of experiments to ascertain the best commercial way of reducing wood to a fibre capable of being made into paper. As a result of their investigations two methods have been selected, (1) mechanical treatment and (2) chemical treatment.

Practically by the mechanical treatment, which con-

sists of grinding up the wood under water, a pulp has been obtained which answers for the inferior kind of paper.

But something more was wanted. Mechanical pulp is used chiefly as an adjunct in the manufacture of news and wall papers and printings, but there are several distinct classes of paper made from mechanical pulp without any other ingredient. Woodpulp boards are also made from mechanical pulp chiefly for the purpose of making paper boxes.

The rapid development of railways and telegraphs; the spread of education; exciting events on this continent, such as the civil war in the United States of North America, combined to create an enormous demand for news, and led to the establishment of many newspapers. The growth of the literary taste led to the development of book-making. In Canada, during the past 15 years, the number of newspapers increased from 644 in 1885, to 1,211 in 1899, and the daily newspapers from 71 to 121, with a circulation in the aggregate proportionately greatly in advance of the increase in the numbers.

The same development, or one nearly equal to the Canadian, taking place in other countries on this continent and in Europe, led to a very enlarged demand for paper, and soon paper-makers found it impossible to meet the ever-increasing demand. Rags, cotton waste, straw, esparto and all the other articles tried and used together were not sufficient. Nor did the price suit. Out of the necessity of the time came the development of the chemical processes and of the mechanical processes by which a good and cheap paper was evolved. Wood paper suited for most requirements was in fact invented.

Chemical pulp is used as an adjunct with esparto, rags or mechanical pulp in the manufacture of news, printing, colours and some kinds of wrapping paper.

By combining chemical pulp and mechanical pulp in the proportion of about 30 or 40 per cent. of the former a good paper results such as can be used with success for most of the purposes for which paper is needed.

But complete success had not even yet been reached. The practical operations connected with the manufacture of pulp from wood by the caustic soda process—such as barking, sawing, chopping, crushing, boiling or digesting, washing and bleaching and soda recovery—had not, even in combination with pulp partly made of wood by mechanical means and partly made of rags, etc., produced the ideal paper.

The world was ransacked for the proper wood. All the earlier efforts at wood-pulp making had been confined to pine wood and to poplar wood. Experiments were also made with the wood of the willow, bass, cedar, hemlock, maple and birch. Experiments were further made with trees of various ages, and in this respect it was found that for chemical pulp trees on an average of 20 years old were the best, the younger growth producing fibre of inferior quality.

The different kinds of wood suitable for the manufacture of pulp are white and black spruce, Canada balsam, poplar, aspen and pine ; spruce and balsam being the most valuable on account of the special quality of their fibre, and also on account of their colour. These comparatively soft woods are easily ground. Poplar and aspen have the same quality but they are faulty on account of knots and black veins which spoil the colour of the paper. Pine which, in the earlier stages of the development of the wood-pulp, was used in far the greatest proportion, is now used only in the manufacture of chemical pulp. It gives a good pulp but the process required to bleach is somewhat expensive. Besides the wood is too high priced to be used profitably in the manufacture of paper. With the low rates that have ruled for paper for some years pulp manufacturers require wood of small value if it can be obtained without the sacrifice of length of fibre.

When, therefore, the chemist hit upon spruce and balsam and found them suitable in every respect for the production of the ideal cheap paper, and commercial men realized that these woods were comparatively cheap, quick of growth and well located for the needs of commerce—

the world knew that at length, after all the centuries of seeking, the right paper, meeting all requirements, had been invented.

It was soon learned that the material could be utilized for the manufacture of many other articles besides paper of various kinds, such as news, printing, writing, wrapping, millboard, etc. Among these are pails, dishes and other hollow ware, paper parchment, cotton wool for hospital dressings, cotton yarn and cloth, silk yarn and fabrics, cigar boxes, medals, cornices, panels and other architectural details, picture frames, car wheels, steam pipes, water pipes, telegraph poles, electric conduits, roofing material, coffins, boats, cigar-holders, carpets, mattresses, lead pencils, artificial straw, shoe heels, vases and ornaments, furniture, horse-shoes, spools and bobbins, tool handles, buttons, cycle bar handles, fruit cans, hats, pinions for machinery, pulleys, letters for signs, substitutes for building stones and for boards, piano cases, tiles, paving bricks, fibre chamois, etc. It has also been used for encasing broken arms and legs.

It was only necessary to find the land which had the best spruce and the best facilities for the production of the most profitable pulp, which at the same time filled the requirements of paper users.

The land of the spruce tree, as of the pine, is Canada. In accordance with a great law of the vegetable kingdom that plants and trees attain their highest excellence along the northern limit of their growth, the spruce of Canada was, naturally enough, believed to be the best. Experiments proved the belief to be sound.

The quality has been tested by the severest tests. The United States of North America have large spruce forests and a very large demand for wood pulp. The United States paper manufacturers have found it profitable to come to Canada for the wood, and in 1899 imported from Canada nearly $1,500,000 worth of wood pulp and pulp wood.

In competition with the Scandinavian stores of woods, Canada, in 1899, sent to Great Britain $700,000 worth of pulp wood and wood pulp.

The latest advices are that an immense trade with Europe in pulp and paper is in sight.

Mr. John Macfarlane, of the Canada Paper Co., reports, as the result of his observations in England and Europe recently, that Great Britain and the Continent form a market that will stand at least half a million tons of Canadian pulp per annum.

The arrangements made in Canada indicate the development that practical men foresee to be probable.

In the Census of 1871 pulp mills were not mentioned. In 1881 and 1891 the Census returns showed the following pulp mills :

Year.	No.	Capital Invested.	Employes. No.	Output.
1881	5	$ 92,000	68	$ 63,000
1891	24	2,900,910	1,025	1,057,810

Since 1891 the increase has been still more rapid, and during the past year or two it has been difficult to keep track of the new enterprises begun and of the old establishments enlarged.

The following is a list of pulp and fibre mills in Canada with a total capacity of about 1,100 tons per diem. The largest has a capacity of 250 tons in each 24 hours and the second largest a capacity of 170 tons. The others range from 100 to 10 tons capacity.

PULP AND FIBRE MILLS IN CANADA.

Mill or Company.	Post Office Address.	Kind.
Toronto Paper Mill	Cornwall, Ont.	Sulphur fibre.
Frankfort " "	Frankfort "	Dry pulp.
Gore " "	Dundas "	Chemical fibre.
Georgetown Paper Mill	Georgetown "	Basswood pulp.
Riordan Mill	Hawkesbury "	Sulphur fibre.
Riordan "	Merriton "	Sulphur fibre and pulp.
Sault Ste. Marie Mill	Sault Ste. Marie "	Wood pulp, dry.
Glen Miller "	Glen Miller "	Pulp.
Thorold "	Thorold "	Mechanical pulp, dry.
Sturgeon Falls "	Sturgeon Falls "	Dry pulp.
Chicoutimi Pulp "	49 Rue Desjardins, Quebec, Que.	Wet Pulp.
Royal Paper "	763 Craig St., Montreal.	Soda pulp.
Canada Paper Co.	Montreal, Que.	Dry pulp, Chl. fibre.
Laurentide Pulp Co.	Grand-Mere "	Pulp fibre.
E. B. Eddy Co., Paper Mill	Hull "	Sulphur fibre, pulp.
Chatham Pulp "	Lachute "	Pulp.
Lachute "	" "	Dry pulp.
Lake Megantic "	Lake Megantic "	Ground pulp.

PULP AND FIBRE MILLS IN CANADA.—(*Continued.*)

MILL OR COMPANY.	POST OFFICE ADDRESS.	KIND.
Dominion Paper Mill	134 McGill St., Montreal.	Chemical fibre, pulp.
Old Lake Road "	Old Lake Road, Que.	Wood pulp.
Jos. Ford "	Portneuf, "	Pulp.
Jacques Cartier Pulp Co.	Canada Life Building, Montreal, "	Ground pulp.
J. C. Wilson & Co	700 Craig St., Montreal.	Pulp.
St. Raymond Co	Montreal, Que.	Dry Pulp.
Société Industrielle du Comte de Maskinongé	St. Ursule, "	Ground pulp.
British Columbia Mills	Alberni, B.C.	Pulp.
Dominion Pulp Co	Chatham, N.B.	Pulp.
Maritime Sulphur Fibre Co	Chatham, "	Sulphur fibre.
St. John Sulphur Fibre Co	St. John, "	Sulphur fibre.
Cushing Sulphur Fibre Co	St. John, "	Sulphur fibre.
St. Croix Paper Co.	Ellershouse, N.S.	Pulp.
Nova Scotia Wood Pulp Co.	Mill Village, "	Mechanical pulp.
Acadie Pulp Mill Co.	Halifax, "	Dry pulp.
Sheet Harbour Pulp Mills.	Sheet Harbour, "	Sulphur fibre.
Sissiboo Falls Paper Co.	Weymouth, "	Wood pulp.

The amount of capital invested, or to be invested in the near future, is between fifteen and twenty million dollars.

At present about one-third of the output is sulphate, or soda, pulp, and two-thirds mechanical pulp.

This development has taken place not only because it has been demonstrated that Canadian spruce is the very best quality for the purpose, but also because Canada is the possessor of the largest spruce forests in the world, and, in addition to quantity and quality of material, possesses advantages in the wide distribution of water power and in the conditions of the labour market, all of which, combined, give her undoubted pre-eminence for the production of paper.

In Canada there is practically an unlimited supply of wood suitable for pulp of the highest character.

The area of Canada upon which the spruce grows is almost conterminous with the geographical boundaries.

Far east, the spruce grows along the shores of Hamilton Inlet and the northern shores of the Gulf of St. Lawrence. Far north, around Ungava Bay, and far north-west in Coronation Gulf, and to the mouth of Mackenzie River, the spruce matures and arrives at good size. Far west, along the fiords of British Columbia, spruce abounds, increasing in quantity as one goes north, and the Douglas fir, a good pulp wood standing midway between the spruce and the balsam, is widely distributed, towering 250 feet in the air and having a base of circumference from 30 to 50 feet.

The extent of the forests of Canada is only beginning to be viewed in its true proportion, even by the people of Canada.

In 1887 Hon. Sir Henri Joly de Lotbiniere made a report to the Minister of Agriculture, on the forests of Canada. In it he says :—

"Let us try and make an inventory of the timber resources of the Dominion, beginning in the West. On

the Pacific shores of the Dominion, in British Columbia, the bountiful gifts of Providence are still stored up for us, and the forests have been scarcely attacked by the lumberman.

"The great forest of Canada, *par excellence*, is spread over that vast territory watered by the Ottawa, the St. Maurice, the Saguenay and their tributaries, over 100,000 square miles in extent. Other timber limits are found in the Georgian Bay country, the Muskoka and Nipissing regions; the Eastern Townships and the south shore of the St. Lawrence, to the Gulf; the region on the north shore of the St. Lawrence from the Saguenay to the Betsiamis, and perhaps still lower down as far as Mingan, and the country watered by the St. John, the Miramichi, the Restigouche and their tributaries. . . . . These timber limits contain an immense supply of spruce."

The Federal Government, and the several provincial governments, employ agents, principally surveyors, well qualified to report on the condition of the land and the forest growth. A great body of these reports has accumulated, and from these, pages by the score could be supplied to show how wide-spread is the spruce in Canada. It must be added that heretofore in Canada pine has been the king, and the search has been rather for pine than for spruce. The acknowledged superiority of the Canadian spruce for pulp has raised spruce to an equality with pine in the estimation of commerce and trade. But, even when all eyes were centered upon the discovery of pine, it was impossible to avoid reference to the abundance of spruce.

In the province of Ontario, north of Lake Nipissing, the surveyors, though specially charged to look for pine, were compelled by the great abundance of spruce to make constant mention of it. Whatever other woods were but partial in the area upon which they grew, and were, therefore, frequently omitted in the enumeration of the trees, spruce is general. Thus in Blezard township, Nipissing District, the surveyor reports:—"Well timbered with spruce, tamarack, birch, balsam, poplar, cedar,

maple, in order named." Of 150 reports examined in connection with the forest wealth of the northern part of the province of Ontario, the greater number refer to the surprising extent and value of the spruce growth, though the primary object of the reports was to discover the extent and value of the pine preserves of the province. Thus Borron, in the narrative of his explorations of Hudson Bay basin (1881), says :—"The timber consists of spruce, aspen, poplar, tamarack and white birch chiefly. Of these the spruce is the most valuable. . . . . The largest trees are about seven feet in circumference." Lyon, in his report of lands in the Rainy River district, says :—"The whole of the country is covered with timber with the exception of spots where it has been burnt. The timber is chiefly poplar, spruce, oak, elm, basswood, cedar, white pine, red pine, jack pine, tamarack and birch."

The Dominion surveyors' reports give evidence of the same desire to discover pine, but these, as those of the provincial land surveyors, describe the abundance of spruce.

The reports of the Geological Survey contain much information on this subject. Thus, in the exploration of Rainy River region, 1887-88, the following is the report: "It cannot be called a pine country though there is some in spots; the prevailing timber is spruce, cedar, tamarack, balsam and hard woods."

In the province of Quebec over ninety reports of land surveyors—made before the great discovery that spruce was *par excellence* the wood for paper pulp—have been examined. These corroborate the conclusions of the surveyors of Ontario. Thus of Bras du Nord of River Ste. Anne and tributaries, the surveyor says :—"The spruce is of greater quantity than other kinds of timber;" of Bay Lake, Ottawa County, the surveyor says :—"Abundance of white and red pine and spruce. Other surveyors report "mechanical spruce," "white and black spruce," "chiefly spruce," "good spruce," over a wide extent of country.

The officers of the Geological Survey report, for the regions under Federal control, that black and white spruce abound. A. P. Low says of James Bay :—"The coasts and inner islands of James Bay are covered with thick growths of small black spruce and larch, along with white spruce, balsam, fir, aspen, poplar and white birch." Even in northern regions, though the trees become dwarfed, yet black spruce holds its own with tenacious grip. Along the outer coast, in the vicinity of Richmond Gulf, he says stunted black spruce and larch grow in clumps only in the low protected gullies, but around the margin of the lakes the trees grow thickly every where, and on its eastern side they rise nearly to the summit of the hills, showing that the climate is more moderate away from the cold waters of the Hudson Bay."

Richmond Gulf, or "Gulf Lake," as it is sometimes called, is on the east side of Hudson Bay, slightly south of the bottom of Ungava Bay. Mr. Low's statement that spruce grows abundantly in the neighbourhood of this lake is conclusive as to the growth all over the great peninsula between the Atlantic Ocean and Hudson and James Bay. The conditions have not changed since 1610, when Henry Hudson, trying to bring the natives to friendly terms, found his efforts frustrated by the Indians setting fire to the woods and placing between him and them a zone of fire.

In the course of a lecture recently delivered, Mr. A. P. Low, of the Geological Survey, described Labrador as a section of Canada a thousand miles long and about the same in width—thus comprising an area larger than Great Britain, France and Germany combined. Of this region enormous tracts of pine and spruce covered the country.

Dr. Robert Bell, of the Geological Survey, says:—"Spruce timber begins to be met with, according to all accounts, about 30 miles to the westward of the Hudson Bay Company's post at Nachvak. To the westward of Nachvak, the northern limit of spruce, according to Capt. William Kennedy, reaches the shore of Ungava Bay, north of the George River. On the western side of

this bay, the Eskimo informed me, it begins to be found in the Bay of Hope's Advance, or five days' journey south-eastward of Cape Prince of Wales on the south side of Hudson Strait, and that in this neighbourhood it was found further north in the interior than on the coast."

Dr. Bell further says :—On the east main coast of the Hudson Bay the northern limit of the spruce was found to be a few miles north of Richmond Gulf, but it was reported to extend much further north at a distance inland from this coast. On the west side of the bay it was seen in considerable quantities all along the coast from Cape Churchill to Buttons Bay ; and Mr. George McTavish, who has made several coasting voyages to the north and who, at my request, has kindly made observations and collected information from the natives in regard to the distribution of timber, informs me that it (spruce) leaves the shore about 20 miles beyond Seal Island. He was told by the Eskimo of these parts, who travel a great deal in the interior, that spruce timber begins to be met with at two days, say 55 miles west of the mouth of Big River, and that it is considerable further inland opposite to Eskimo Point, which is about in latitude 61° 40′ North. From this neighbourhood it runs west, north-westward, and crosses the Coppermine River about 20 miles from its mouth and thence reaches nearly to the Mackenzie River." This testimony corroborates the statements of Messrs. Simpson & Dease and Richardson and other early explorers of the northern littoral of Canada who report the presence of good sized spruce trees.

In the Province of New Brunswick there are several pulp mills of considerable capacity, in the aggregate amounting to about 140 tons per diem. Mr. Chalmers, of the Geological Survey, began an examination of the province in 1882. During the intervening years he has studied that section of Canada with care. The result, so far as the flora of the province is concerned, is of the most satisfactory character. In his first report he says:—"The black spruce is probably the most abundant tree in the district." (North-west New Brunswick).

In the report of 1885, taking in the whole province, he says:—"The chief trees are white spruce, balsam fir, &c., on the more elevated and drier grounds, and on the swampy grounds we find spruce fir, white birch, poplar and white cedar in abundance." In later reports Mr. Chalmers tells of the rapidity with which the second growth of spruce covers the sections of the country upon which the forces of destruction have exercised their most powerful influence. Without any care, without any forestal supervision, nature unaided, not even given fair play, has been able to carry on the reproduction so successfully as to create an equilibrium.

In the Province of Nova Scotia the comparatively greater degree of moisture stimulates the growth of the forest, so that though the demands have been made during a longer period and to a larger extent than in some other portions, the spruce still abounds and pulp manufacturers have set up four or five mills for the production of pulp.

From an investigation made in 1894 it appeared that from 38 to 40 per cent. of Canada consists of woodland and forests. That is about 1,400,000 square miles. If one half of this area is spruce there will be about 450,000,000 acres of spruce area in Canada. In the manufacture of newspaper wood pulp according to present methods, a cord of spruce wood is estimated to equal 650 feet of board measure, and this quantity of raw material will make half a ton of sulphate pulp or one ton of ground wood pulp. Newspaper stock is made up with 20 per cent. of the sulphate pulp and 80 per cent. of the ground wood pulp. Now, as figured by experts, the best of spruce land possesses a stand of about 7,000 feet to the acre. This is equal to 6 tons of sulphate and 11½ tons of ground wood-pulp per acre.

Taking ground wood pulp as the basis and 10 tons per acre as the product, there are 4,500,000,000 tons of wood pulp in sight in Canada.*

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*In a paper read before a number of persons interested in forestry, since the text was written, Dr. Bell, Assistant Director of the Geological Survey, estimates the area of the northern forest of Canada at 1,657,600,000 acres. This, he calculates, would yield 16,500,000,000 cords of spruce. The estimate in the text is therefore a very conservative one. (See Appendix A.)

Great Britain and the United States consume yearly about 900,000 tons of pulp wood—which is the product of about 90,000 acres of spruce woodland to be denuded of its spruce every year to supply the demand of these two countries. At that rate it would take 50 years to destroy the present existing spruce crop. But spruce reproduces itself, to the sizes best suited for pulp, in 30 years. As the first 90,000 acres cut over would have 50 years to reproduce the second growth, it is evident that the spruce forests of Canada can stand all demands upon them without fear of total deprivation in the lapse of time.

Experts, in order to indicate the great area in Canada occupied by the spruce as its habitat, have declared that in Canada an area equal to that of England could be cut over every year and still the reproductive powers of the spruce would maintain the equilibrium of demand and supply. There may be exaggeration in this statement but it fairly enough gives expression to the immensity of the area filled for the growth of spruce.

In the Province of Quebec it is estimated that there are 200,000,000 acres of timber limits mostly timbered with black spruce, the most valuable of all woods for pulp and paper purposes.

There is still another consideration of great importance in estimating the value of the wood-pulp industry. The black spruce is considered to be better than the white for pulp. As the black spruce grows on the hills and rocky ground, while the white spruce loves the valleys of the streams and other situations where there is more soil, it follows that we have a much larger extent of black than of white spruce forest.

The premier of the province recently stated that in 1892 spruce limits were sold for about $8 per mile, while last year (1899) the Government sold similar limits for $150 per mile, the price thus rising, under the pressure of demand, nearly 19 times what it was seven years before.

The evidence of surveyors and of the officers of the Geological Survey has been adduced to show the area of spruce in Canada.

A few quotations from practical manufacturers will emphasize the statement already made respecting the quality.

The "Manufacturer," of Canada, says :—"It is a generally expressed opinion now among the paper makers that Canadian pulp is distinctly superior to that made in Norway, and still more so compared with Swedish pulp. Much of that superiority is to be attributed to the nature of the wood itself ; the fibre seems to mill better and is certainly of a tougher and finer texture."

During a recent visit to Canada one of the principal of the London publishers said :—"During the past ten years I have paid several visits to Canada. I have always held, as the outcome of my observations, that Canada must, through her enormous natural resources in regard to the paper trade, become in time one of the most important factors in paper manufacturing for the whole world. Our (English) paper makers have already begun to realize something in regard to what Canada can do for them ; and the leading manufacturers in this particular line have demonstrated to their entire satisfaction that Canadian spruce makes a stronger sheet of newspaper than the Scandinavian varieties. It is certainly longer and stronger in fibre, which makes it a far better sheet for newspaper offices to print on with the fast rotary machinery. . . . . Canada is destined to become, through its illimitable tracts of spruce and other woods, not only the foremost wood pulp making nation, but the paper manufacturer of the world, more particularly of the lower grades, such as newspaper." *

The "Canadian Trade Review" of February 10, 1900, says :—"It is a striking testimony to the many advantages of Canada for establishing a pulp and paper manufacturing business, that after having scoured Russia, Norway and Sweden and the United States for a location for the immense mill they intend to erect, the large English firm of Edward Lloyd, Limited, have finally decided to start their new paper industry in Canada. This

*Mr. S. C. Phillips, of Messrs. Phipllis & Co., London, Eng.

SAULT STE. MARIE PULP MILL

is, therefore, an emphatic corroboration of the statement we have so frequently made that no other country in the world offers such advantages to the pulp and paper manufacturing trade as does Canada."

Within a few days (February 21st, 1900) arrangements were made public between the Imperial Paper Company and the Lloyds. These show that the latter have purchased from the Paper Company part of their concession from the Ontario Government for three quarters of a million dollars. The Paper Company agree with the Ontario Government to carry on a pulp-making business with a capacity of at least 6,000 tons of pulp a year, for which purpose they are constructing a paper mill at Sturgeon Falls with a capacity of 20 tons a day. This means the expenditure of $1,000,000, the manufacture of 30,000 tons of paper and the continuous employment of some 250 hands.

The increasing demand has led the Company to begin the construction of a second paper mill with the intention of adding others till the capacity attained is 120 tons a day.

The paper mill at Sault Ste. Marie is an evidence of the extent to which capitalists are availing themselves of the opportunities afforded by Canada for the profitable employment of capital in the production of wood pulp.

This paper mill ships 500 tons of pulp per month to Japan—sending one-fifth of its make to that country. The massive building, a photograph of which is given, is but in its infancy. The present buildings are used for the manufacture of mechanical pulp. A second building has been erected, having the same capacity as the first, viz., 100 tons dry weight of mechanical pulp daily. A third and a fourth pulp mill, each of 50 tons daily capacity, are in construction for the manufacture of sulphate and of soda pulp. The power available to drive these mills is calculated at 40,000 horse power.

The establishment at Grand Mere, River St. Maurice, is also on a large scale. The Laurentide Pulp Co. has invested over $3,000,000 in this establishment. The company employ in the rivers, woods and works over three

thousand men. They have built in the very heart of the forest a town containing 5,000 souls ; a modern village up to date in every respect, with water system, electric light, and well laid out streets.

Their timber limits cover an extent of 1800 square miles. The water power developed and used is about 16,000 horse power. The full water power at driest season of the year is 70,000 horse power.

The plant this company employ consists of the saw mill, the daily capacity of which is 160,000 feet, board measure ; and a wood-preparing room in which the wood for the manufacture of ground wood pulp and sulphur pulp is stripped of its bark and prepared. In this room the company prepare daily 3,000 logs of an average length of thirteen or fourteen feet, and diameter of twelve inches.

The digester plant consists of a tower 160 feet high in which are tubes filled with limestone. Sulphur is burned in iron and brick retorts at the base of the tower. The fumes pass through long cooling pipes and then stream up through the limestone. The water, which is contained in tanks at the top of the tower, percolates through the limestone and meeting the sulphur fumes forms sulphurous acid which passes through pipes into large stone tanks and from there into the digesters, these latter being filled with chips. The acid comes into contact with the chips—live steam is turned on and the mass is cooked. When sufficiently digested the cooked pulp is blown into a tank where it is washed with water to remove unnecessary acid. Other processes follow till the article is finished ready for shipment or for use in the various manufactures in which the company is engaged.

In addition to this chemical pulp the company, of which Sir William Van Horne, K.C.M.G., is president, have a good plant for the manufacture of mechanical pulp. The company estimate that their shipments for this year will exceed 400,000 tons.

In addition to the possession of such abundance of the right kinds of wood as will justify expenditure of the

GRAND MÈRE PULP MILL

large fixed capital necessary for buildings and plants, water powers are needed. These have to be extensive, widely distributed, and within easy distance of transportation facilities.

Brebeuf, one of the early Jesuit missionaries, leaving Three Rivers for Lake Huron by way of the Ottawa River, relates that during his journey he had to carry his canoe over thirty-five portages because of the rapids and cataracts encountered.

The hydrographic condition of the rivers the burly Jesuit traversed, in his bare feet, nearly three hundred years ago, remains the same to-day as then, and in each of these rapids and cataracts which were a source of annoyance to the zealous pioneer, there is to-day a reserve of horse power calculated to delight to an even greater degree the souls of those who seek locations for pulp mills and water power to drive the machinery, than these same rushing, roaring water falls disturbed Brebeuf's equanimity and put to severe test his philosophy and his religion.

The water falls, over which energy has been running to waste for centuries, at the command of science have had given them a value and a use that most vividly suggest the transforming power of chemic science.

LaSalle passed up the St. Lawrence River from Lachine and made his way by its great lakes to the Mississippi River; as his light canoe bore him on its broad bosom past wide prairies over which countless herds of buffaloes grazed and nature, in her animal and vegetable life everywhere seen, proclaimed her vast prodigality. The adventurous Frenchman of the seventeenth century rejoiced because he believed his mission to be to call into light the hidden riches of the western land and to add to his own and the world's wealth. The student, macerating in his tubes different woods by various processes to meet the loud-voiced demand for the cheap newspaper, performed for civilization a service scarcely less meritorious when he discovered that in the spruce wood of Canadian forests there was the needed combin-

ation of strength, abundance and cheapness the world for years had been seeking.

To run a mill capable of producing 25 to 35 tons of ground pulp per diem requires a motive power of from 2,500 to 3,000 horse power. The generation of such motive power by means of steam is a costly matter, and experience has demonstrated that pulp can be manufactured profitably only in those places where power can be supplied by water.

A glance at the map will show that Canada is one of the best watered countries on the globe. Everywhere there is water, and from the geological character of the country water falls are abundant.

Thos. C. Keefer, C.E., C.M.G., in the course of a presidential address before the Royal Society of Canada, says :—"An examination of any good map of our broad Dominion reveals, as its most striking feature, an extraordinary wealthy and remarkably uninterrupted succession of lakes and rivers, suggestive of ample rainfall, the first great requisite in the occupation of any country. Over a length of several thousand miles, between Labrador and Alaska, and over a width of several hundred miles, there is an almost continuous distribution of lakes, lakelets and rivers; the lakes of varied outlines, dimensions and elevations above sea level, and many possessing facilities for the storage of their flood waters. In many places the outlet from the lake or the connection between a chain of lakes is a narrow cleft in rock where an "inexpensive dam will hold back the water supplied by the winter's accumulation of snow."

With the exception of our prairie region the rivers of Canada differ from those draining the western and central States of the United States of North America, in that they are not naturally navigable from their mouths or above tidal influence to any considerable extent, except in detached sections. The great rivers of the Mississippi, the Missouri and the Ohio are navigable for thousands of miles and are, therefore, without water power. They flow upon a nearly uniform grade of a few inches per mile, while the St. Lawrence and its tributaries, and in

CHICOUTIMI PULP MILLS

fact all the great rivers of Canada, east and west, are interrupted by rapids, chutes and cataracts, affording a great variety, quantity and quality of water power.

From the Straits of Belle Isle to Montreal, and thence ascending the St. Lawrence, the tributaries of the St. Lawrence and of the Ottawa descend, through the Laurentian region, from elevations of 1,800 to 1,000 feet above tide. In many cases they bring their principal cataracts very near their outfall, notably in the case of the famous falls of Montmorency, which, leaping directly into the St. Lawrence from a height of 250 feet, are utilized to supply power to a cotton mill not far from their base, and to light the streets and drive the tram cars of Quebec city ten miles distant.

A short time ago an examination was made by the Ottawa Board of Trade into the resources of the region tributary to Ottawa. Estimates were obtained from surveyors, engineers, mill owners and others possessing full knowledge. It was found that within a radius of fifty miles there was an available power of water equal to nearly 900,000 horse power, the Ottawa supplying 664,000 horse power, and its tributaries 226,225 horse power; those on the Ontario side contributing 40,000 horse power, and those on the Quebec side 186,225.

This estimate is based upon a low average of water obtainable throughout the year.

At the sources of the twelve or fourteen rivers, which together aggregate the 900,000 available horse power mentioned, are great lakes that can be converted, by the construction of retaining dams, into immense reservoirs, by means of which the power can be increased. Estimating the value of the electrical horse power generated by the use of water at $10 per annum, the water powers in the area described represents the sum of $9,000,000. Estimating the value of horse power generated from steam on the basis of $25 per annum, it represents the great annual value of $23,000,000.

This power is all within such easy distance of the federal capital that it can be centred in Ottawa over a

comparatively small number of miles of wire with a loss of only 8 to 10 per cent. in efficiency.

Mr. Surtees, C. E., who has investigated this question for the Ottawa River, gives the following information of the capacity of this river and its tributaries to supply power :—

ABOVE THE CITY OF OTTAWA.

	Horse Power.
Great Chaudiere, Ottawa City (not in use)	35,000
Little Chaudiere	25,000
Deschenes and Britannia	15,000
Chats Falls	141,000
Portage du Fort	49,000
Mountain Chute	62,000
Grand Calumet	186,000
Coulonge River	24,120
Black River	21,000

MISSISSIPPI RIVER.

	Horse Power.
Galetta	1,800
Pakenham	900
Blakeney	1,080
Rosamond's Rapids	720
Almonte	3,000
Appleton	540
Carleton Place	1,000
Innisville	540

MADAWASKA RIVER.

	Horse Power.
Arnprior Rapids	1,400
Burnstown	1,400
Springton Rapids	1,120
Calabogne Lake	3,640
Madawaska High Falls	10,360

BONNECHERE RIVER.

	Horse Power.
Castleford Rapids	1,120
Renfrew and Douglas	2,000
Quyon River	80

TRIBUTARIES BELOW THE CITY.

GATINEAU RIVER.

	Horse Power.
Farmer's Rapids	24,500
Chelsea Mills	47,790
Eaton's Chute	24,508
Cascades	14,000
Wakefield	12,000
Paugan Falls	73,500
Péche	375
Petite Nation River	1,600
Blanche River	1,600
Priests Creek	240
Little Blanche River	250
Clay Creek	120

RIVIERE DU LIEVRE.

	Horse Power.
Buckingham	9,000
Rheaume Falls	4,000
Dufferin Falls	12,500
Upper Falls	12,500
Little Rapids	500
Cascades	2,000
High Falls	36,000

These figures give a total of 589,320 horse power above the city of Ottawa, and 269,683 horse power below the city, all of which is at present unused—the total in use being 58,400, giving a grand total of 917,403 horse power.

This estimate, as has been stated, is for water power within a radius of 50 miles of the city.

Beyond that no detailed estimate has been provided. Mr. Andrew Bell has estimated the aggregate water power available between Ottawa and Mattawa (200 miles) at 1,476,000 horse power.

The engineers of the projected Montreal and Ottawa and Georgian Bay Canal estimate the water power developed along the route of the canal at 700,000 horse power.

On Sturgeon River emptying into Nipissing Lake, and, therefore, tributary to the projected canal, the power available at Sturgeon Falls, Smoky Falls, and one or two other points, is approximately 50,000 horse power, part of it being utilized by the Imperial Paper Company, already mentioned.

On the Montreal River there is a 150 feet fall within the first three miles, and a 180 feet of a fall in the distance to Lake Temagami.

All this immense reservoir of power is included in 300 miles of a river which is over 600 miles long.

Still further, the building of the dams proposed in connection with the Montreal, Ottawa and Georgian Bay Canal, it is calculated will increase the power between Sturgeon Falls and Montreal by 500,000 horse power—which is equal to the amount developed on the United States side of Niagara Falls.

Take another locality. The deep and sombre River Saguenay acts as the drain of Lake St. John. This lake is fed by many rivers and streams. These are fine reservoirs of power. Beginning on the east side the Peribonka River is navigable for a dozen miles from the lake. Then come the Grand Chutes. For five or six miles the water of the Peribonka rush through these chutes by a series of water falls capable of supplying a force of 300,000 horse power, which can all be harnessed to do the world's work at an expenditure of a comparatively small sum of money—comparatively, that is to the cost required to secure the force utilized at Niagara Falls of but one-sixth of the horse power capable of being employed in the falls of Peribonka River.

The Mistassini River is another of the feeders of Lake St. John. On it, within 24 miles from the lake, there are two falls not far from each other. These taken together can supply a force of 40,000 horse power.

One of the affluents of the Mistassini River is the Mistassibi. Its waters pass into the parent river by a succession of cascades whose collective force is estimated at 75,000 horse power.

Another of the tributaries of the Mistassini is the River of Rats. The waters of this river mingle with those of the Mistassini by means of two cascades of 30 feet and a water fall of 60 feet ; estimated to be able to supply a force of 22,000 horse power.

Perhaps the largest tributary of the Mistassini River is the Assiemska, whose rapids and cascades are of such a character as to warrant the statement that several thousands of horse power are there waiting to be set to work.

It is safe to say that there are, north and east of Lake St. John, within a sweep of 20 miles, not less than 150,000 horse power.

The River Chamouchouan, which is considered to be the upper part of the Saguenay River, falls into Lake St. John south of the Mistassini. It can contribute as its share of the water power of the favoured region, not less than 100,000 horse power, supplied by several cascades, and especially by the falls of the Chaudiere, which have a height of 120 feet.

The River Ouiatchouan has a length of 60 miles and in reaching the Lake St. John widens into several lakes, of which the most important is the Lac des Commissaires, which is a lacustrine expansion of 21 miles in length. At a couple of miles from its mouth the river has a fall of 230 feet high, capable of providing a force of 33,000 horse power.

The Metabetchouan, in a distance of 80 miles (125 kilometres), has a descent of 225 feet—the greater portion of which is accomplished by means of cascades and rapids—within a distance of 4 miles.

Here, then, in the single region of which the basin

of Lake St. John is the great water reservoir, are rivers and streams having over 700,000 horse power, capable of being utilized for manufacturing purposes. This, it is stated, is a power much in excess of that which could be supplied by the rivers of Norway and Sweden.

This territory of Lake St. John has an area of 19,000,000 acres, of which less than half a million have been stripped of their wood; the remainder are in forest.

Three-quarters of these forests are white, black and red spruce. The other quarter contains spruce, birch, cypress and pine.

The quantity of wood for paper pulp is, therefore very large.

Taking the very low estimate of five cords to the acre as an average yield of the region, the following table expresses the immense resources of the region :—

REGION.	EXTENT (Acres)	CORDS OF PULP WOOD.
Peribonka	8,320,000	41,600,000
Mistassini	4,800,000	24,000,000
Chamouchouan	3,200,000	16,000,000
Ouiatchouan	3,200,000	16,000,000
Total.....	19,520,000	97,600,000

It will be seen at a glance that even at the very lowest estimate of a cord and a half of wood for each ton of chemical pulp, there is in sight, in this region of Lake St. John, sufficient material to provide for a demand of wood pulp of 1,000,000 tons a year for 65 years—without taking into consideration the reproductive powers of nature.

In a word, this one little bit of a water centre of Canada has a forest area equal to the whole forest area of Norway, or to more than one-third the forest area of

Sweden, and has within this area 700,000 horse power of water fall, cascade and rapids, waiting to be harnessed in order to provide cheap power for the reduction of the best kinds of pulp wood to wood pulp and paper.

These are but two examples of scores that might be adduced to show the great capacity of the rivers and streams of Canada for the production of water power easily utilized in the manufacture of wood pulp.

The St. Lawrence River and all its tributary rivers, the St. John, Miramichi and Restigouche Rivers and their tributaries, the mountain-fed streams and rivers of British Columbia and the numerous water privileges of Nova Scotia, testify to the exceeding abundance of water courses specially fitted for the production of power in all those portions of Canada where the spruce abounds.

The Falls of Niagara have a theoretical force equal to seven million horse power, of which one-half belongs to Canada. This means several thousands of available horse power capable of distribution over a large area of the adjacent country. It has been estimated that the St. Lawrence River, from source to end, has a capacity of ten million horse power.

The canals of Canada are also capable of supplying power to be utilized in manufacturies of all kinds.

Thus in regard to quantity and quality of the best wood pulp material, and the facilities for manufacturing and transporting the manufactured article to Europe on the one hand and to Asia on the other, Canada stands pre-eminent.

APPENDIX A. (Page 18.)

In our Canadian forests, east of the Rockies, there are ninety species of trees, but the greater number are confined to a comparatively small area. In our northern forests the principal trees are cedar, balsam (fir and poplar), aspen, white birch, tamarac or larch, banksian pine and white and black spruce.

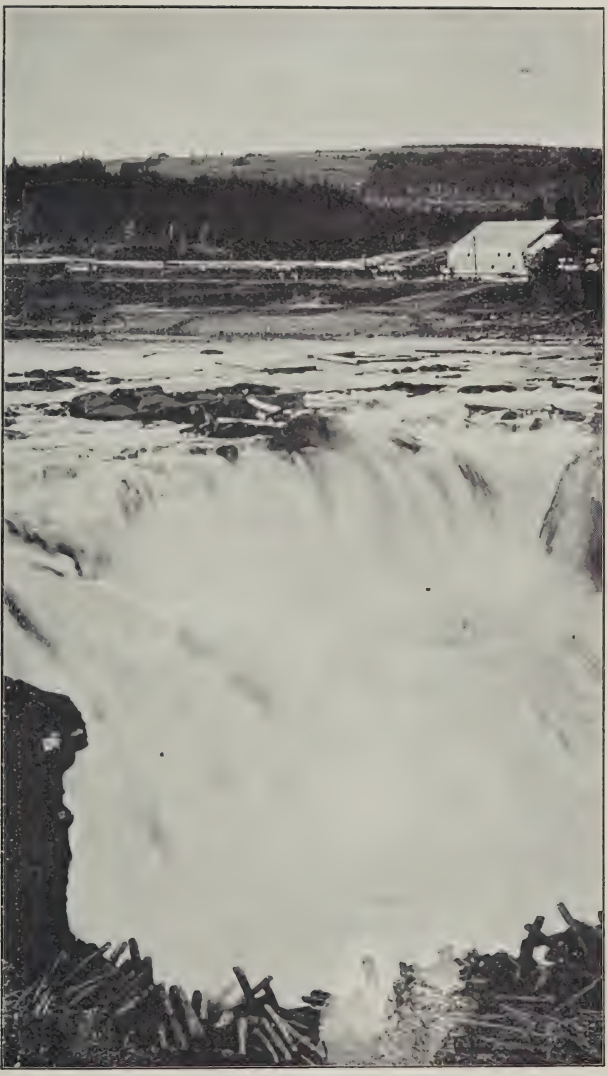
The dimensions of our great northern forests are so vast that they seem almost incredible. The central line of the forest belt may be described as starting from the vicinity of the Straits of Belle Isle, and following a west south-westerly course till it passes to the south of James Bay, then turning north-west it follows this course all the way to the border of Alaska, opposite the mouth of Mackenzie River, the total distance being 3,700 miles. The breadth of the spruce belt taken at ten almost equal intervals in the above distance is as follows:—

	MILES.
From Halifax to Ungava Bay	1,000
In the Labrador Peninsula	950
From the north shore of Lake Huron to Richmond Gulf, on the east main coast	800
From the international boundary on the northwest side of Lake Superior to Cape Henrietta Maria, on Hudson Bay	600
From the international boundary on Lake of the Woods to Cape Tatnam, on Hudson Bay	600
From Yorkton, East Assiniboia, to Fort Churchill	600
From Battleford to the limit of forest north-east of Raindeer Lake	600
From the summit of the Rocky Mountains on a north-easterly line passing through the Athabasca Lake	800
From the water shed of the Pacific slope on a north-easterly line passing through Great Slave Lake	700
From the water shed of the Pacific slope on a north-easterly line crossing the Mackenzie River on the Arctic circle	350

This gives an average breadth of 700 miles. If we mutiply the total by this breadth the result is an area of 2,590,000 square miles as the approximate area of our northern forests, in which the black and white spruces are the prevailing trees.—DR. ROBERT BELL, Assistant Director Geological Survey.

BONNINGTON FALLS, BRITISH COLUMBIA

CHAUDIERE FALLS, OTTAWA



GRAND FALLS, ST. JOHN RIVER, N.B.

SASKATCHEWAN RIVER RAPIDS

PERIBONKA FALLS, QUEBEC

METABETCHOUAN FALLS, QUEBEC

CHAT'S FALLS, OTTAWA RIVER

STE. ANN'S FALLS, QUEBEC

GRAND DISCHARGE, SAGUENAY RIVER

KAKABEKA FALLS, ONTARIO

CHELSEA FALLS, QUEBEC

HIGH FALLS, QUEBEC

OUIATCHOUAN FALLS, QUEBEC

KAMANASKIS FALLS, ALBERTA

LIEVRE RIVER FALLS, BUCKINGHAM, QUEBEC

WIACHEWAN FALLS, EAST COAST HUDSON BAY

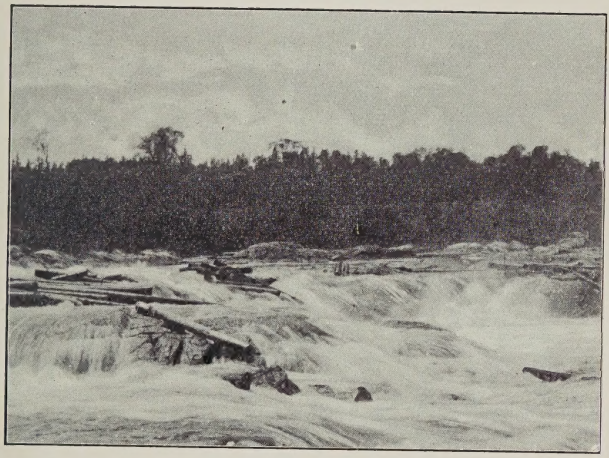
MONTMORENCY FALLS, QUEBEC

CHAUDIERE FALLS, QUEBEC

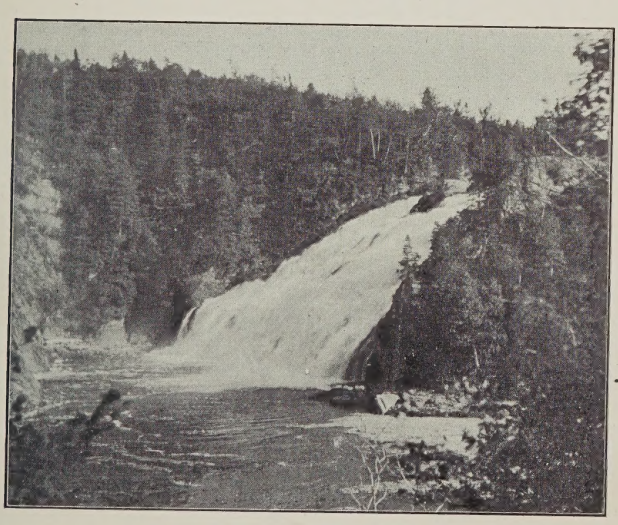
MANIWAKI HIGH FALLS, QUEBEC

SHAWINIGAN RIVER FALLS

UPPER FALLS, SISSIBOO RIVER, N.S.



FORT FRANCIS FALLS, ONTARIO



RIVIERE DU LOUP FALLS, QUEBEC